Fraunhofer-Institute for Optronics, System Technology and Image Exploitation IOSB

OPC-UA as enabling technology for plug-and-work on MES level

Miriam Schleipen

Espoo, October 9, 2012


Karlsruhe


Ettlingen


Ilmenau


Lemgo

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Agenda

1. Terms and motivation
2. Goal and enabler: OPC UA
3. Plug-and-work on MES level by means of OPC UA based middleware
4. Conclusion and Outlook

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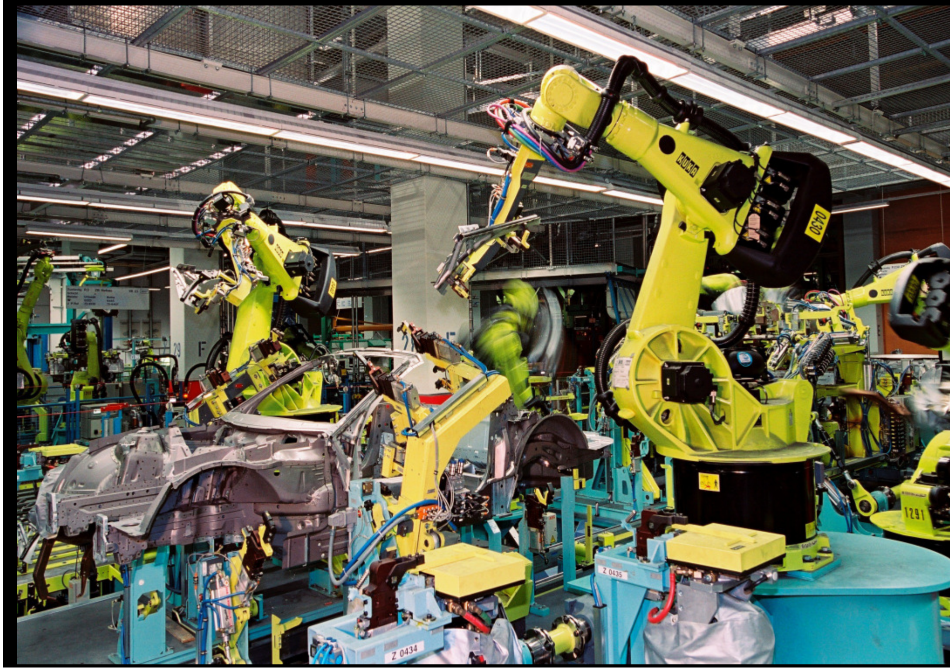
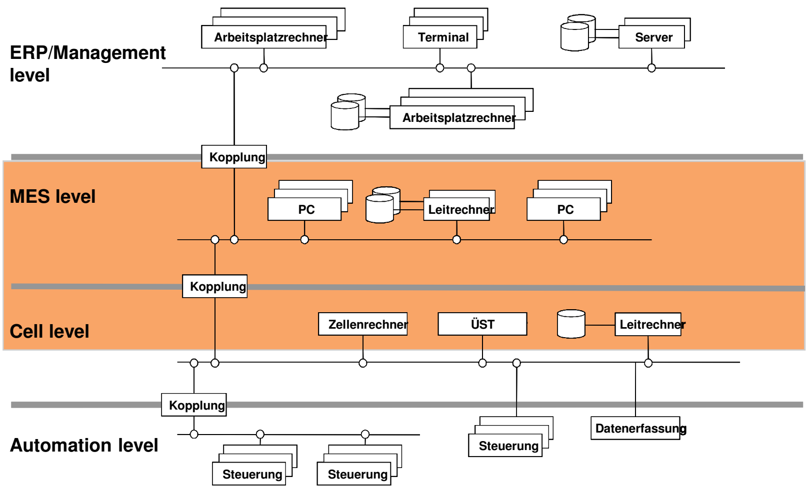
Realtime IT for complex manufacturing processes



1. Definition ‚production-related IT-Systems' [Betriebshütte, VDI 5600-1]



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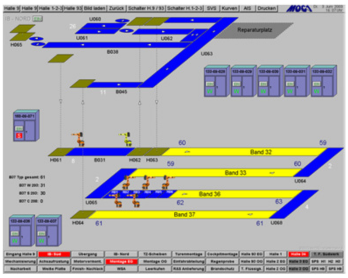
1. MES at Fraunhofer IOSB

- Manufacturing Execution Systems (MES)
  - Are production management software systems with direct access to the field controllers e.g. PLCs
  - Aggregate actual state of production and calculate KPIs
  - Are a system type with specific domain language within the heterogeneous IT landscape in production environment
  - Collect and use data and information from different heterogeneous data sources
- The integrated monitoring & reporting system from IOSB consists of
  - ProVis.Agent® for monitoring & control,
  - ProVis.Visu® for real-time visualization,
  - ProVis.Paula® for web based reporting.



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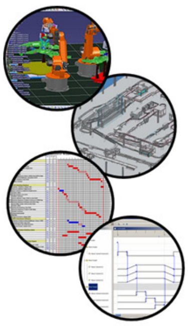
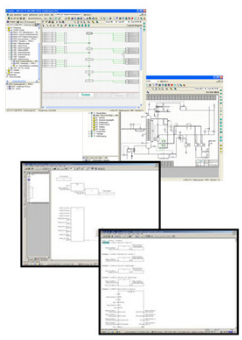
1. Motivation

- Plant planning process = complex process divided into several planning phases with many different disciplines involved
- Before using a production monitoring & control system: Engineering
- Engineer gets information as hall layout, signal list, etc. and creates visualization manually → time-intensive, cost-intensive, error-prone
- Usage of one homogeneous data and modeling format for the exchange between different tools would help





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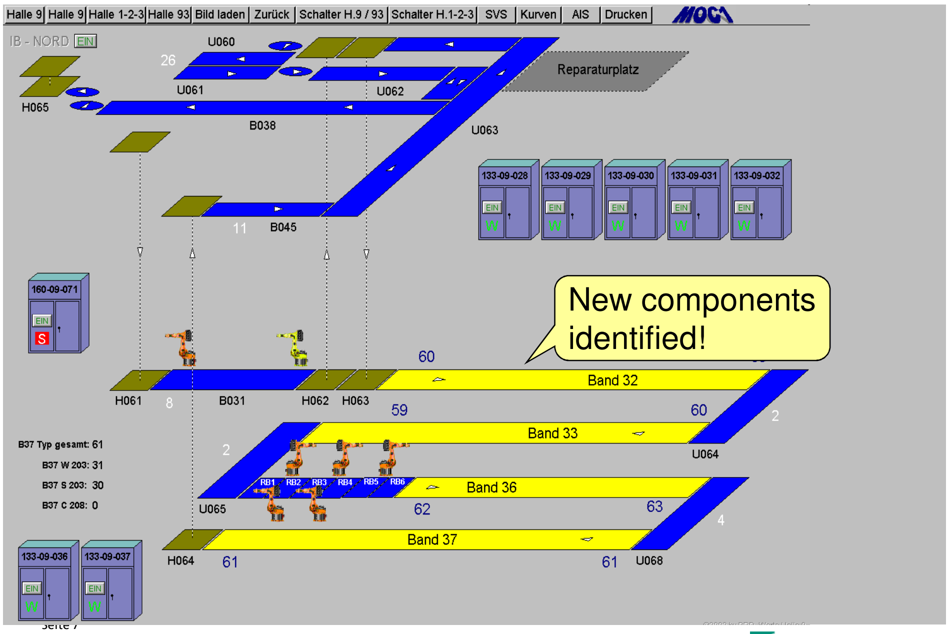

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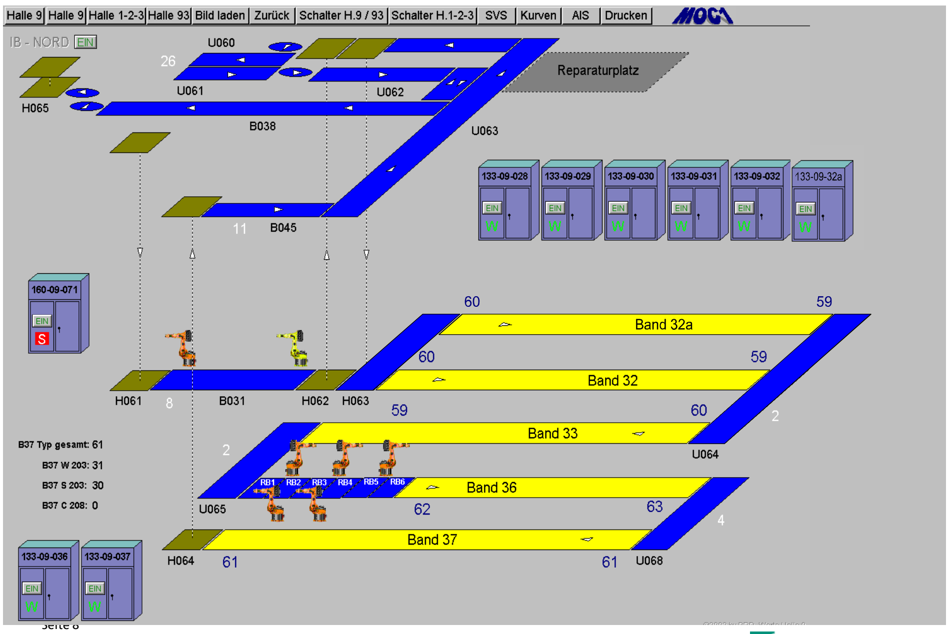

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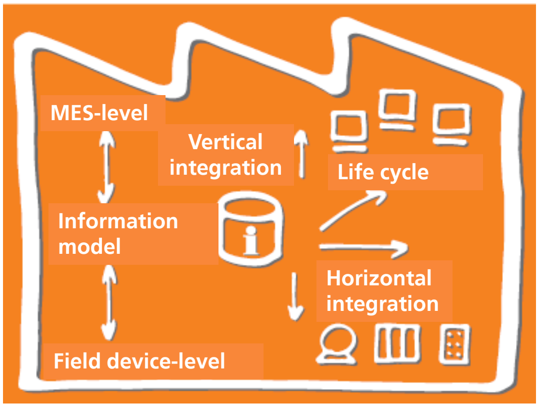
2. Goal and enabler

- Consistent data for MES and engineers involved in production planning
- Enhanced data exchange
- Integrated computer-assisted planning
- Simplified production planning and re-planning (on MES level)
- Problems
  - What to communicate? (content)
  - How to communicate? (process)
- **Enabling Technology: OPC-UA**



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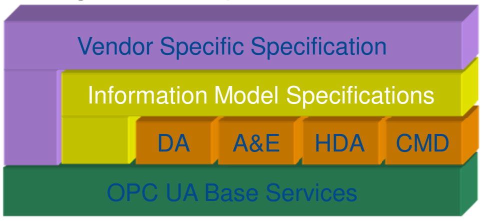
2. OPC Unified Architecture (OPC UA)

- Provides mechanisms for the standardized, asynchronous, distributed communication
- Supports process communication in a structured way
- Unifies all previous OPC-based technologies under a 'platform-independent umbrella'
- Base services: abstract method descriptions
- User-defined information model: Full-mesh network of nodes
- Fraunhofer IOSB is corporate member in OPC Foundation
- Since 2007 we use OPC UA in different industrial research & development projects
- Production monitoring & control system ProVis.Agent supports OPC UA as one communication possiblity



Source:
OPC DevCon 10.-12.10. 2006, München
T.J. Burke, OPC Foundation

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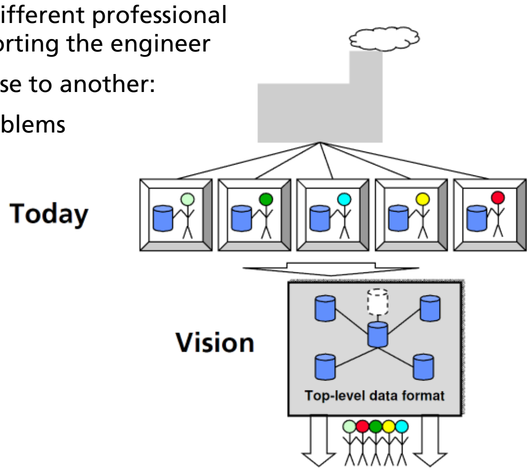
2. OPC UA as enabling technology

- Within planning phases: Different professional and specialized tools supporting the engineer
- At transition from one phase to another:
  - Data incompatibility problems
  - Semantic gap
  - Data exchange via excel, telephone, or paper based information (e.g. printed hall layout)
- **Solution: Intelligent middleware using OPC-UA**



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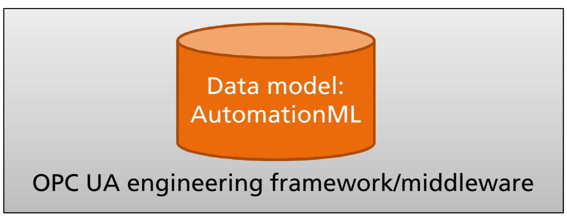
3. Intelligent middleware using OPC-UA

- How to communicate?
  - OPC UA as standardized communication technology for planning data & electronic change propagation
- What to communicate?
  - AutomationML as standardized exchange format & integrated data model



- Supports mechatronic, cross-discipline plant engineering

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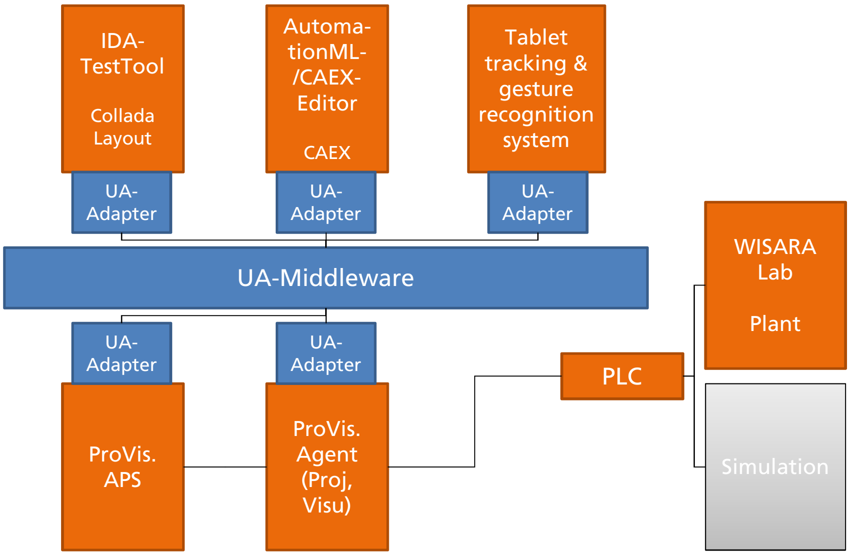
3. Data management and communication middleware

- Architecture:
  - Middleware server
  - Clients with adapters to middleware
- Requirements
  - Read and write data in different structures
  - Support implementation of AutomationML as data model
  - Connection monitoring and communication
    - Problem handling (connection interrupt, communication problems, …)
    - Access rights
    - Real-time requirements ←→ no data loss
    - Asynchronous data transmission
    - Support of different HW platforms (e.g. Windows, Android, …)

3. Data management and communication middleware



3. Data management and communication middleware

- Standardized communication
- Well-defined interfaces for all involved partners
- Integrated information model
- Change management
- Change propagation
- Different views on data

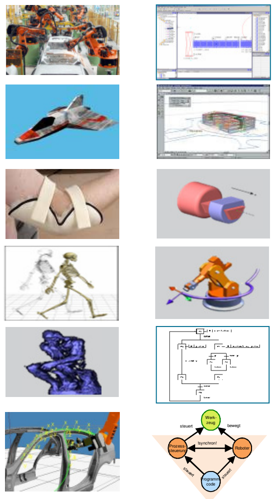
→ OPC UA was made for these requirements (originally)
→ No further effort

3. AutomationML as glue

- Unified language
- Plant description
- Close gaps
  - Between product development and production
  - For interoperability between tools
  - For all phases of engineering
  - Based on a scalable data format
  - As open standard with market acceptance
- Actual status: Progress towards IEC standard series

3. Mechatronical units with AutomationML

- Topology
- Geometry
- Kinematics
- Motion planning
- Behavior
- Handling processes



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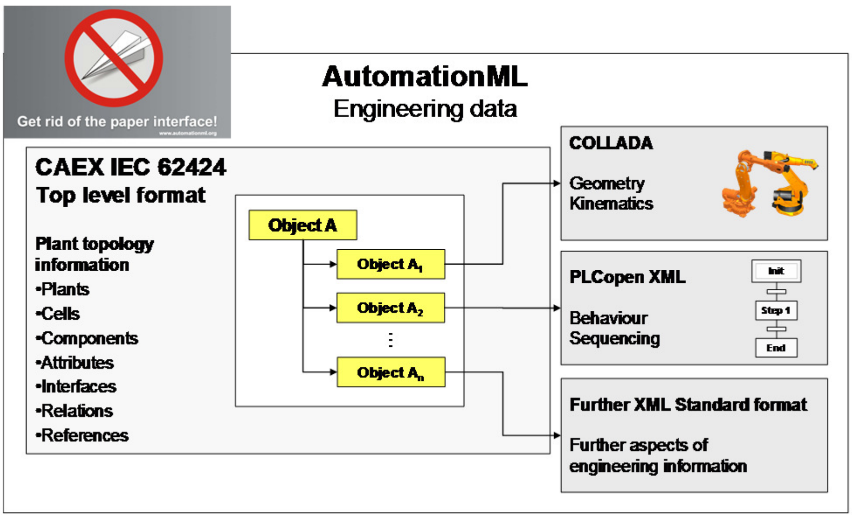
3. Top-level architecture of AutomationML



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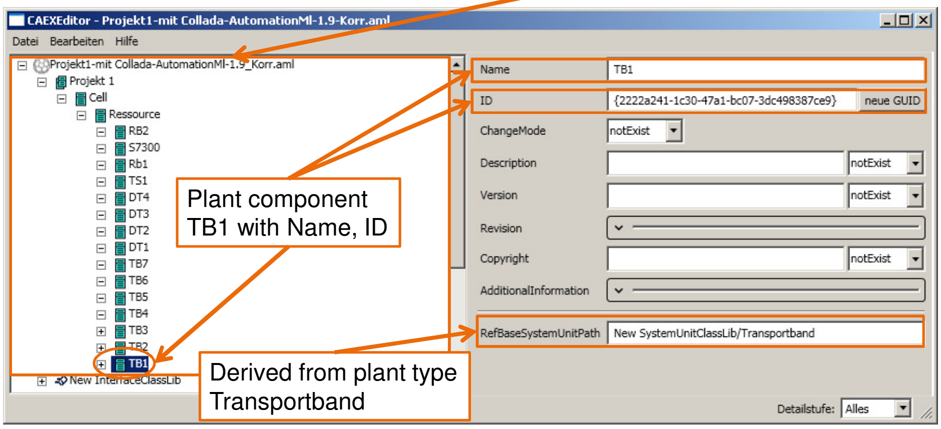
3. Example: AutomationML model – plant components

- AutomationML includes different library types (plant component types, interfaces and roles) and a concrete plant hierarchy with ist components



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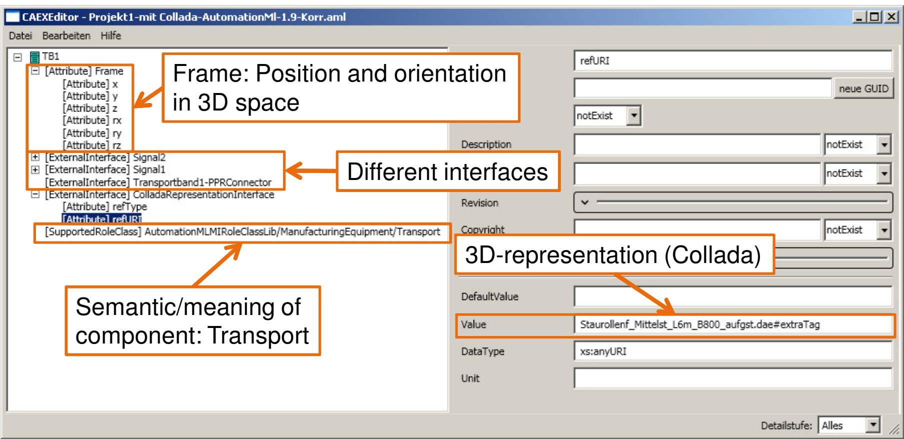
3. Example: AutomationML model – information about single component

- Detail information for TB1 (CAEX and COLLADA)



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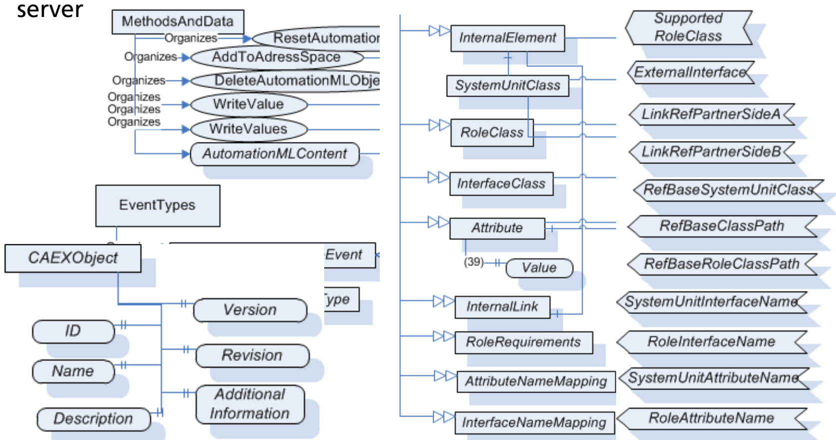
3. Data base, data modeling and data management

- Communication infrastructure based on OPC Unified Architecture (UA)
  - Implementation of AutomationML model in information model of UA server



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3. Example: Digital Engineering Table - DigET

- Public funded research project, 2010-2012
- Interactive assistant system for multi user engineering
- Combination of standards such as AutomationML and OPC UA with assistance mechanism and an interactive environment
- Consistent planning and intuitive interaction with IT systems (e.g. via gestures)
- Multi display hardware environment with interaction possibility and collaboration assistance
- OPC UA middleware with integrated AutomationML information model and conflict handling

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4. Conclusion and Outlook

- Conclusion
  - MES needs engineering information from different other tools and disciplines
  - → Need for an integrated data model
  - OPC UA is enabler for plug-and-work mechanism
  - Combination of standardized data format AutomationML and standardized communication and data processing technology OPC UA
  - Integration of AutomationML as information model in OPC UA
- Outlook
  - Necessity to rely on existing UA companion standards
  - (MES is current topic within OPC Foundation)

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Thank you for the attention!

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Impressum

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Espoo, October 2012

Miriam Schleipen
Fraunhofer IOSB

miriam.schleipen@iosb.fraunhofer.de
www.iosb.fraunhofer.de/ilt
www.klkblog.de
Tel.: +49-721-6091-382
Fax: +49-721-6091-413

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